CONSCIOUSNESS IN THE BRUTES.[1]

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Such are some of the considerations which tend when taken together to deprive the nervous system of its preeminence as the representative of consciousness in animals, a supposition which naturally arose from the former's peculiar function of being the chief means of associating impulses passing between the really active tissues of the body and between their parts. On the other hand certain events in the realm of chemiphysics have recently altered somewhat our view of matter itself and this alteration bears in a sense on the basal relations or unity perhaps of mind and body. Matter is proven in certain cases at least to be not something fixed and immutable but rather centers of spontaneous forces active despite all known conditions, and the tendency is undoubtedly to place force where formerly matter stood. In biology the same tendency has long been felt, for it is seen that those reactions we summarily call vital are indiscriminately composed of heat, movement, electricity, light, etc. But now that similar phenomena are seen to take place in inorganic substances as well as in protoplasm, it is obvious that little is left of the "substantial" part of matter. Just as a limited and rationally forced pan-psychism is in the philosophical air, so this pan-energism or pan-kineticism (if I may be pardoned the rude terms) is in the physical air. To the one view (the substantial rational seeing of Idealism) nervous processes as well as mental processes are psychical and the body itself is sentient experience. To the becoming physical view, matter is something akin to a vortex of kinetic energies and the brain, in the last analysis, becomes reduced to the powers of chemiphysical attraction and repulsion, of heat, of electricity, of light, of chemism, modes of movement. Both to physics and to epistemology protoplasm is a somewhat whose chief characteristics are movement, change, indescribable because unique but identical in terms of consciousness. Deny it as one may with wealth of dialectic, with statement heard so often that "force and movement are not consciousness but force and movement," still consciousness does seem more like these various forces to which protoplasm bids fair to be reduced by physics than like the lumps of white and greyish matter from out the interior of a bony skull, and to this extent the becoming view of physics and the liberal view of consciousness approach each other. If consciousness is not a force still it has some of the qualities of force as we know it,—and no matter what force is as we don't know it! Is this heresy to orthodox idealism, to claim the forces of protoplasm and the thing we call consciousness alike in some respects and to base on this similarity an increased claim for the wider locus of consciousness? At any rate, the sole contention is that the becoming conception of protoplasm including nerve as made up of molecules or of clusters of molecules which are, even physically, reducible to centers of chemic force, makes it somewhat easier to conceive of some sort of correspondence between consciousness in animals and the mechanism of their life. The difficulty is not to see this this way but rather to persist in spite of basal resemblances in maintaining a contrast based alone on a logical syllogism. Above, we urged the usefulness of this very syllogism at the basis of idealism—at present we urge its limitations when the basal paradox of our experience demands that we should do so. A few years ago most physicists would have claimed the doctrine of the conservation of energy infallible in our experience; to-day he may see hints of phenomena which relegate it perhaps to the limbo of other tottering theatrical idols! If simple metals exhibit phenomena of this sort, surely we may expect from a substance as highly elaborated as living protoplasm relations at least as aberant from the supposed laws of matter. And protoplasm finds only one of its forms, and that apparently not the most active chemically, in the protoplasm of the nervous system.

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The structure of protoplasm, of late gradually made out conjecturally at least, offers a prëemiently appropriate and adequate seat or representative for consciousness—its uniqueness and the uniqueness of sentient experience correspond. Let us glance at some of what are probably the salient features of this substance bioplasm, biogen, or protoplasm, "life-stuff," "life-bearer," "primal matter." Each year enlarges our knowledge of it as obtained through the microscope, and continually its general chemiphysical nature becomes better known. Into the theories of its morphology we need not go, for surely it is its basal chemic constitution and not its physical structure which underlie its relations to consciousness. If biochemistry has learned anything surely about the structure of biogen it is that the group or cluster corresponding to the molecule of inorganic matter is of unique complexity and of a maximum instability. Among the constituents of this substance and probably of every cluster composing it are three materials organic in nature and each of great complexity. These three, of course, are proteid, fat, and carbohydrate, and proteid constitutes nearly the whole. Besides these there are water and an unknown number and variety, very large, of salts which elsewhere are termed "inorganic," here doubtless part of the biomolecule, or life-unit. Of these five classes of constituents of this vital unit every one is a compound and three at least of them of great complexity, especially so the proteid. No two analyses of the many forms of this substance are alike and no one at all represents the original substance, for chemical analysis inevitably kills it and its structure chemically depends on its life. There is no doubt that all of the proteids contain hundreds of "atoms" in their units and many of them thousands. To account for the spatial arrangement of these thousands of atoms the imagination must be actively employed, but the problem is simplified by considering the "atoms" stresses and strains, forces, rather than as space-filling material bodies. The fats of the vital molecule and the carbohydrates are also complicated in molecular structure with scores of "atoms," and in instability only secondary to the proteids, while the inorganic salts form combinations with these in the life-unit group which are quite unknown. All of these "atoms" are continually interchanging as the vital unit anabolizes or katabolizes, and not only interchanging with themselves but with other more or less similar complexes brought to them as food. Of all the "molecules" known to chemistry, this one, probably, at the basis of protoplasm and of life is the most complex in its ever-changing construction and probably has as its essence a metabolism quite unique. This metabolism, these most intricate chemical interactions within and between these vital clusters making up protoplasm can be occasionally *imagined* by the chemist who knows the nature of chemical reactions generally and the materials and end products of these vital processes, but they cannot be described by him. From them are set free motion, heat, light, electricity, power of various sorts, phenomena we call forces. Nowhere else than in the living tissues of animals are the causal or the effected conditions so complex and inter-involved, and above all so capable of permanent adjustment to varying relations. Such a uniqueness is fit concomitant for the uniqueness of consciousness. This intricacy of forceful interaction would seem to supply the only apparent basis for the intricate phenomena of the mental process. On the one side a living body made up of events like these implied, almost too complicated to be even suggested by other than a biochemist — on the other side the indescribable experience consciousness. Only these two of all finite things are reasonably adequate to mutually represent each other it may be.

And there is at hand an illustration of this relation which is more than rational fitness and probability. That protoplasm, bearing no immediate relation whatever to any nerves, is capable none the less of representing and of containing within its activity at least latent psychical characteristics is seen by us all continually in the fact of the heredity of psychical characteristics — or else consciousness is indeed the secretion of the brain and La Mettrie was right and Leibniz and Spinoza, Plato and Hegel quite beguiled. The extremely minute speck of protoplasm constituting the male element in reproduction carries in its molecular structure or activities not only the physical but also the psychical peculiarities of the father of the new individual —or else we must retire to materialism. Strength of will, temperament, affections of various sorts, even habits of thought (such, for example, as those which lead to suicide in successive generations), all are commonly transmitted, besides a host of characteristics as much mental as bodily. Twins are often nearly alike not only in psychophysical but in purely psychical respects. There must be a basis for these aspects of consciousness; no other basis is transmitted than the speck of protoplasm; hence this speck must be the basis required —the climax of human mystery. The interactions between the units and within them, kinetic relations in the last resort perhaps, stand in the spermatozoan for psychical events. If so many and so various determinants of consciousness inhere in a male pronucleus, where nerve is not as yet, why then not a portion of consciousness in the quite comparable protoplasm of the active tissues of a developed being? No theory of heredity as yet suggested attempts to account for a relation of this nature, just as no details of a doctrine of psychophysical parallelism will be expected when the consciousness of protoplasm in general shall have become recognized as an element of its vitality, basally inherent in it.

The phenomena of sleep and of its analogues strongly implies that there is more in consciousness than the nervous system can adequately represent. Unconsciousness is not to-day a scientific any more than it is a metaphysic verity, for grant a nervous break between the waking and the sleeping consciousness (in sleep normal, in coma abnormal, in sleep easily bridged, in coma seldom or never), and with exceptions the sleeping consciousness has the extensity if not the intensity of the waking experience. These exceptions are especially the senses of seeing and hearing, which being in part closed off leaves us nearly the sleeping consciousness. Sleep is particularly the resting of the nervous system, as measurements show, while some of the bodily metabolism is likewise decreased. When the nervous system rests the person "loses consciousness," the mysterious break between the two states gradually or suddenly occurring, yet no person is awakened suddenly, unless too violently, without finding himself in the midst of some sort or other of mental experience, often with all the characters of the waking consciousness minus the overwhelming experience of flooding daylight and of universal sound. Such a mass of consciousness is not perhaps adequately represented by the metabolism of a few grams of grey nervous matter in the cortex cerebri but only by a general bioplastic metabolism in the mass of the body cells which know no rest corresponding to the sleep of the individual. An increase in the metabolic activity of any portion of the body-protoplasm is apt to at once break into the sleeping consciousness, oftentimes with vigor sufficient to recall the waking consciousness by stimulating the nervous system out of its repose. In sleep the sub-conscious mass of experience predominates, represented as it is perhaps by the somatic or protoplasmic, as distinct from the nervous, portions of metabolism.

We have now reviewed certain considerations which tend to connect the activity of animal protoplasm in general with consciousness in general. In this vague relation is a "correspondence" which is not subject to the close limitations of a supposed parallelism between consciousness and neural tissue alone. If the correspondence cannot be worked out in detail neither can the details of the events themselves in either of the two correlatives concerned, while on the other hand idealism supplies a logical hypothesis of their relation if not one to satisfy psychophysiology. Now all these complex protoplasmic conditions are found in every sort of animal tissue in some degree or other, the degree depending in general on the respective activity of any tissue in an organism. Thus bone and connective tissue for example have little epithelium and nerve and muscle much. It is of these various sorts of protoplasm that the bodies of all the animals we know, brute as well as human, are composed. The protoplasm of all, so far as we know, is of equal chemical complexity, and as richly endowed with the interactions which form a reasonable basis for a material fit for accompanying consciousness. Thus for example the ameba, simplest of animals, lives on protoplasm as its food, and the enzymes which digest it and the chemical processes which make these enzymes are doubtless as complex as those which make them in a human pancreas. Again in the ciliary movements of many of the protozoa one can see (without seeing a trace of nerves) as perfect cöordination and adaptation to a complex purpose as complete as is to be found anywhere in man himself. Man but shows his egotism when he claims himself superior on any biological standard to the simplest of animals—the true measure is rather one of protoplasmic fitness, or else one quite outside the range of biology, namely in ethics, in the possession of a will free to do right or to do wrong. Looked at broadly, unbiased by our human habits of thought, what reason is there, if these statements are facts, to assume as preliminary in every discussion of the consciousness of the brutes, that the consciousness of each species and of each individual even, corresponds to the complexity of its nervous system? Back of any possible correspondence between organic process and mentality is the unique complexity of chemic protoplasmic activities and this is present in all animals so far as research has shown in equal degree. It is a matter of the existence rather than of the quality of consciousness in any form of life, the quality and the intensity as well as the extensity of the mental processes depending undeniably on the extent to which the division of bioplastic labor has gone in any particular form or individual.

We have above offered a number of presumptions, but certainly there's more than a reasonable "presumption" of the existence of consciousness in the brutes, especially from considerations like the following: Says Mill, "When two things resemble each other in one or more respects and a certain proposition is true of the one, it is probably therefore true of the other," and all the whole world so far as rational at all works and lives on this principle of analogy plus the calculus of probability. The person skeptical of brute-consciousness knows himself conscious and knows more or less of his own body's structure and the mode of that structure's life. This is the "certain proposition" which "is true of the one." Now here, instead of there being "one respect," in which the analogues brute and man are similar there are thousands of respects, there are almost as many scattered up and down the animal series as there are known facts in the physiology of animal life. The conclusion is logically, that is to right common-sense, all but a syllogistic certainty. Outside certain innate mathematic analogies there is hardly any probability greater than that the most evolved brutes are conscious, man being so. Muscles, nerves, and glands, all are constructed similarly, act on the one same plan, serve the same biologic purposes —the muscles to achieve movements, actions, the nerves correlation and adjustment, the glands bodily supply, the other tissues for more mechanical service as groundwork of the rest.

The sceptic who admits his own consciousness but denies it in the dog and elephant and lion has one resource which he is bound to make use of continually. He can deny the principle of continuity in organic evolution and claim that the protoplasm of man is essentially different from that of all other animals, and that the difference is such that consciousness may inhere in it and not at all in the brutal organism, the consciousness accruing to it suddenly as if out of Pandora's box. So arbitrary, however, is this supposition, so gratuitous in the biology of protoplasm that it may be disregarded, the burden of proof resting wholly on its claimants. So far as every evidence goes, structural and functional, the two classes of animals compared, brute and human, are built on the one same plan, live in the light of the same consciousness save probably for ratiocination which has perhaps developed with the vast complicating of the connections of the fibers of the brain and the consequent development of abstract symbols into speech and language. The burden of proof in this matter rests with the deniers of the analogic probability.

Now going along the multitude of animal forms toward the simplest animal from the most human, where can a line be drawn beyond which consciousness may be disclaimed? With wonderful morphologic variety there is striking biologic uniformity, the same use of the same mechanical principles and of chemical reactions and assuredly of protoplasmic nature generally, so that even in ameba, the simplest, indeed the logical limit of animal structure, we find the same events in type and the same means for producing these events —metabolism in irritable living protoplasm. Even in ameba is that same amazingly complex protoplasm whose chemiphysical interactions science is beginning only to unravel. Cöordination in ameba is poor and we find him sometimes trying to crawl in opposite directions for a brief space, for of nervous matter there is of course nothing. For the same reason the animal's adjustment to external conditions is imperfect, although in the main protective of its life. But all the varied metabolism is there, giving rise to the same sort of heat, motion, and probably electricity, from the same protoplasmic life, supplied by the same nutrients and giving off the same katabolic waste as does a nerve cell or any other cell of a human body. Without a single nerve-fibril the naked protoplasm conducts impulses, as one may quickly see when the whole animal nearly at once contracts after stimulation, and cöordination and even adjustments occur without anything which can be called nerve. Without muscle contraction takes place. Without separate gland-tissue secretion goes on. Without reproductive cells the marvellous so-called simple division of the animal occurs whenever its overgrowth demands, a process compared with which even mitosis is easy to understand. In ameba then, the logical limit of animal simplicity, a minute drop of uncolored streaming protoplasm, the matter is organized as forces which interact and are mutually and self-sustaining. The adjustment of relations which is its life is nearly as perfect as in other animals and because the chemiphysical process at the basis of this series of adjustments is perhaps even more complex than elsewhere (since every function nearly inheres in every part), a modicum, a trace, a sample of consciousness must be supposed to be concerned.

What can be supposed as to the nature of this requisite consciousness of ameba? Shall we imagine it like our own? Of course not. Can we imagine it at all? Scarcely so, it must be allowed, and yet, "the dim crawling life" is part and parcel of a system of uniformities in which we ourselves and our own consciousness partake and within these limits we can imagine much. It is customary for descriptive psychology to say that the most prominent aspects of mind as we know it are feeling, will, and thought. The first, feeling, is based wholly on sensations, on modifications of consciousness which seem to have to do with that protoplasm, which in man and his congeners is made up as sense-organs. Ameba's protoplasm and that of other unicells is universally sensitive to irritating stimuli, and its irritation causes reactions exactly comparable to those of protoplasm elsewhere under the influences coming from sense-organs. A dim and simple sensation-mass would seem then to be a reasonable basis and substance of ameba's consciousness. Besides this there are obviously elements of which we know as will or action and this involves that something else, that "certain plusness," not to be defined but representing perhaps in its last analysis the life itself, action, active purposiveness that quality by which the interactions of ameba's molecules exceed in complexity and in self-adjustment those of other self-regulating materials—if indeed any such besides bioplasm exists. Another word for will is conscious spontaneity and possessing this the animal may still be as much the slave of circumstance as you please for its dependence on its environment is extreme. Sensation-mass and will, conscious spontaneity, such we may imagine are present in ameba's consciousness. In these nerves are unnecessary, and their physical basis is adequately enough the universally complex. irritable, and active protoplasm of which the whole body is composed. So much for this logical type of animal, a speck of undifferentiated bioplasm. In this form we are interested only for these very reasons —that it is the logical type and it is undifferentiated protoplasm only.

In the series of animals from ameba "up" (no scale save a very indistinct one can be made out), we find at once development in the way of a division of labor. Scarcely are we out of the protozoa, the unicellular animals, before certain cells of the various organisms begin to take on distinctly the qualities and uses of nervous tissue, the first form being cells with a new vigor and promptness of reacting to stimulation, it being therefore the sense-organ part of the nervous system which appears first in the phylogenic development. In this simple plan these sensitive cells are also means of defense. In animals a little more complicated we find the rudiments of a nervous system entire, the first form being a mere line or lines of fibrils, with the necessary nerve-cells, connecting parts required to work in unison for some reason or other, or where adjustment of any sort is necessary, functional connection being the business of these fibers primarily and always. In forms of life more and more complicated, the nervous system's reticulum of fibers shows corresponding development, not only in actual intricacy, but in relative mass. Thus in a way the nervous system comes to be a rough general index of the complexity of any animal's life, of relations more and more involved, not only between cells and organs within the limits of the animal, but with numberless conditions outside the individual yet part of its environment and in a biologic sense inseparable from itself. Conduction, cöordination, adjustment, appreciation, become more and more complete as the vital conditions demand. Small portions of the protoplasm develop into sense organs and the corresponding sensation-mass of the animal we may suppose becomes "larger" and richer with inevitably a tinge of feeling in its nature. In very simple forms muscular tissue of a simple sort has already developed, actions thereupon are made more promptly and in a more perfectly adjusted way and therewith the will has developed also in richness and in strength, as represented by what the various animals variously *do*.

As a glance backward over the literature on the will quickly shows, the theories of its nature and of its relation to organism on the basis of the phenomenal dualism are many and complicated, for in this notion will or volition is involved the heart of the question as to any sort of correspondence. If we think of will as found in the brutes as spontaneous activity we cannot be far wrong, but if we do so, we at once express the unification of the mental and the bodily. "Will" at least, whatever "sensation" and "thought" may mean, means nothing whatever unless within it is included bodily activity. Here then is the empirical or scientific corroboration of the epistemological viewpoint and for once the two views are in fact unified, as well as logically. The scarcely experienced "certain plusness" or fiat in the willing-process as we describe it psychologically appears phenomenally as the *activity,* kinetic, chemic, atomic, molecular, and molar, of the components of protoplasm. In no other way is the fiat, the relation of the two aspects, experienced, for all the rest of the volition is sensation arising from this activity.

In this way of thinking the sensation-mass of the brutal experience joins with an almost intelligible activity in the protoplasm and in the environment its sensations represent to constitute the larger part of its consciousness. It is only by this free and easy transition back and forth between physical and psychical, between protoplasmic activity and experienced will and sensation, that any sort of explanation is forthcoming as to the relations of body and soul. We must, really to explain, merge the scientific and the epistemologic, the phenomena with the sentient experience of the phenomena. To the dualist even this degree of explanation seems forever forbidden.

But if sensation and volition constitute the by far larger part of the brute's consciousness (as of man's) what of cognition, the faculty of knowing, an analytically distinct aspect of the mental continuum? Scarcely yet have we escaped the exaggeration which the associationists forced into psychology and man's pride is reluctant to admit how small the proportion of cognition and especially of constructive conception in his mental process minute by minute. Who can doubt that in the brutes the proportion of conception is not much smaller still?

If cognition, understanding, thought, etc., be a comprehending of relations (and little else when the sensation of perception are taken out), perhaps it is not extreme to suppose that on the bodily side this comprehending, or taking together, will imply the proportional development of those organs which receive, collect cöordinate, compare, and adjust. No other organ or system in animal bodies except the nervous system performs these functions, the sense-organs the nerves and the nerve-cells.

Whether the relations comprehended be derived from stored traces in the grey matter of the nervous system or be brought in anew to it from without the process is one peculiar to nerve, and only suggestions of the faculty exist in protoplasm itself, other than nerve. If ameba collects, cöordinates, and adjusts, it does these slowly and imperfectly as compared with more evolved forms of possessing nervous systems. Whatever then our compelled notion of ameba's consciousness must, we can think of its cognition only as at the logical limit, the vanishing point of reality. As the nervous system and its various sense organs, however, become more complicated, the comparing and cöordinating powers of the animal become more adequate. The fibrils making up the system become general in the other tissues, ramify more widely, gradually connect more universally, while their knots, the nerves-cells, perhaps also distributing centers of nutrition, probably become more complicated, although less numerous relatively. The universal neural reticulum is connected not only with more sense-organs but with more kinds of sense-organs themselves always more and more complex as we look up the series of animals. Becoming progressively greater in mass in proportion to the grey matter, the conducting paths become also more complex and their interconnections ever more involved, thus representing more and more perfectly the consciousness which so far as expression and conduct indicate becomes also more and more complex. If the grey matter of the nervous system represents the switching and adjustment of impulses, besides nutrition, the white net of fibrils stands for the essential cöordination of bodily influences. In the simpler animals there is neural simplicity in every way apparently, the complications coming later being not only in connection but in structure—a condition which neither use nor observation necessitates as true as regards the body-protoplasm generally. Thus with developing nervous systems, the animals up the animal series gradually acquire the comprehension of associated relations which little by little approaches the faculty we see evinced in the most knowing of our brute friends and victims. One sees well enough that rabbits and sheep are less intelligent generally than are cats and dogs, for example, and the ant's faculty of overcoming difficulties far exceeds that of the cray fish. These differences have a physical basis in the proportional quantity of grey matter of the nervous systems and, as the physiologist knows, in the way the nervous matter is arranged in the brain cortex and in the nerve trunks sometimes. In general, in short, one can see a correspondence between the complexity and mass of the nervous system, and especially of its grey matter (the comparing part) and the cognitive processes of the animal. Knowing then corresponds to the nervous system because reception of relations, and their cöordination, comparison, and adjustment, are at once the basis of cognition and the special function of this system alone.

But understanding and adjustment to simple new relations such as we see in the most knowing of the brutes does not mean necessarily conception and abstract thinking, and self-consciousness arising therefrom. The recent work of Stumpf and his colleagues on the calculating horse Hans shows these relations well. Here is an animal which probably through an unusually plastic or extensively ramifying nervous system has developed a faculty of observation especially of its questioner's face which seems to equal that of the most expert of human physiognomists. Perception and recognition form the adequate basis of this brute's unusual powers and the investigators could find no trace of any appreciation of any numerical concept not unified with the percept of the questioner's face. The orang outang, Joe, which visited this country seven or eight years ago left a quite similar impression on the minds of many of his psychologic observers. No proof then of conceptualization in the brutes is to be furnished either by the animals themselves or by their human apologist. It is not enough to be able to see in the deep eyes of a fine setter dog expressions sometimes like those of man under like conditions, for these expressions arise rather in what one might call an emotionally tinged simple cognition than in an abstract conceptual experience. Indeed, if both theory and observation may be trusted no sort of cognitional function beyond perception rendered more useful by memory, and so going on to recognition often with an affective tone is to be proven or evidenced by any brute's expression or conduct.

It was from this sort of consciousness perhaps as a beginning when speech had been acquired (perhaps by a Mendelian "chance" variation in heredity), that man in the course of millions of years has developed special limited mental processes whch have made invention and through that civilization possible. In the boundless multitude of the abstract notions humanity has thus acquired one sees represented, very possibly, the size and complexity of the hemispheres of man's brain. This difference in consciousness, probably the greatest to be found in the whole range, is sufficiently accounted for, it may be, by the development of language—but even this blessing may be over-done!